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REPORT OF STUDIES ON UNIFORMITY OF QUALITY OF SUGARS

I. Chemical and Physical Studies on Beet Sugars of the 1943 Campaign

By C. A. Fort and S. Byall

II. Biological Studies of Sugars

By H. H. Hall and Dorothea J. Teunisson

Agricultural Chemical Research Division

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REPORT NUMBER XXIII

PREFACE

Through the continued cooperation of the beet sugar companies and the operating personnel of their factories there were received composite samples of sugar from each of the 60 factories operating during the 1943 campaign. These sugars have been examined chemically, physically, and biologically. Five additional beet sugars were also included in the studies.

In Part 1, which directly follows, is presented (1) a summary of the operating data which were submitted with the sugar samples, (2) the chemical and physical data obtained on the sugars, (3) comparative ash values for white massecuites and sugars of the 1941 campaign, and (4) a summary of specific conductivities and ash values of the past four years. The tabulation of regional averages is omitted. The limited number of factories operating, and the shifting of three normally Steffen factories to non-Steffen operation, led to average values which could not fairly be compared with the results of previous years.

The usual biological examinations of the sugars are reported in Part II beginning with page 41. There is also included a brief report of preliminary experiments designed to establish a basis for comparison of mold growth promoting substances in high density solutions of the different sugars.

PART I

CHEMICAL AND PHYSICAL STUDIES ON BEET SUGARS OF THE 1943 CAMPAIGN

By C. A. Fort and S. Byall

As in recent reports the process as well as analytical data are tabulated in dual tables, that is, each table number has a separate portion for non-Steffen and Steffen operations, respectively. The special material presented in tables nos. 9 and 10 are not thus treated. The extra samples 4394, 4395, and 4396 are not included in preparing the averages. The three parts of sample 4356 were averaged and the mean included in the general averages.

Again the barley candy tests were omitted as the time available for examination of the sugars was limited by other necessary work. It is probable that the gravimetric determination of ash may soon be discontinued as it is evident that conductrimetric ash is quite satisfactory and all constituent analyses, except silica and ash alkalinity, are now made directly on sugar solutions.

PROCESS OR OPERATING DATA

(Tables 1 - 4, incl.)

1. Quality of Beets and Diffusion Juices

The average sucrose in beets was the highest since 1939, showing an average increase over the 1942 campaign of 1% sucrose on beets. The 1942 average was exceptionally low. About two-thirds of the factories reported an increase in sucrose content above the 1942 level, which more than compensated for the lower sucrose experienced at the remaining factories. In many instances the sucrose was the highest in the past ten years. The purity of the diffusion juice showed a slight increase over

1942 but not as much as might be expected from the contrast in sucrose. The density of the diffusion juice reflected the increased sucrose as it was increased by almost as much as the sucrose value.

2. Liming and Carbonation

The lime used at Steffen factories decreased to correspond to the decreased amount of molasses worked. Lime used at non-Steffen factories was slightly but not significantly increased. The average amounts of soda ash used were slightly greater than in 1942 and especially at Steffen factories may have been partly responsible for the lower content of lime salts in white massecuite.

Of the factories operating only four used batch first carbonation but nearly half used batch second carbonation. Of the latter, the majority were non-Steffen. Only one change from batch to continuous carbonation was reported. The alkalinities of carbonation showed no significant change. About one-half of the pH values after 2nd carbonation fall in the range of 8.8 to 9.3 pH, inclusive. The remaining values were below or above these figures.

3. Sulphuring

The total sulphur used shows a slight increase as indicated by averages especially for Steffen factories. It will be seen that the sulphite content of the sugars was increased. Only four factories applied the sulphuring solely on thick juice, over two-thirds sulphured thin juice only.

TABLE I

PROCESS DATA, NON-STEFFEN

Sample Number	Beets		Diffusion Juice		Lime Used %	Soda Ash lbs.	Carbonation Alkalinities		2nd Carb'n		Thin Juice pH
	Sucrose	Purity	Brix	Purity			1st	2nd	Temp. C°	pH	
4301	15.79	85.1	11.4	87.2	2.89	0.03	0.089	0.017	--	--	8.7
4303	15.70	--	10.7	87.8	1.34	.11	.065	.--	88	9.1	7.7
4304	17.08	--	11.4	87.2	3.94	.00	.066	.015	96	--	9.3
4305	16.75	85.4	13.1	87.7	2.00	.02	.077	.018	95	8.9	8.6
4306	18.29	84.8	14.9	86.5	3.00	.00	.081	.016	--	--	--
4308	16.19	87.8	13.4	89.6	2.13	.13	.092	.015	--	8.9	8.1
4310	16.62	--	11.8	88.6	1.24	.28	.066	--	90	9.3	8.2
4311	15.70	--	12.1	86.3	1.51	.18	.081	--	84	9.5	8.1
4313	16.68	87.5	13.7	88.2	2.65	.01	.093	.014	97	--	8.2
4314	15.70	84.0	13.7	85.7	2.18	.21	.059	--	86	8.8	8.4
4315	15.67	83.8	13.5	84.0	2.03	.29	*--	--	96	8.9	8.5
4316	17.91	86.3	14.5	87.6	2.22	.19	*--	--	108	8.9	8.2
4317	17.32	--	14.1	87.4	3.08	.00	.078	.018	98	9.0	9.0
4319	16.81	82.0	12.1	84.2	2.69	.51	.061	--	90	9.0	9.0
4321	17.13	84.0	14.7	84.5	2.49	.58	.082	.018	98	8.8	8.1
4322	16.27	--	11.3	88.4	1.37	.07	.071	--	89	9.4	7.9
4325	16.38	--	12.6	88.0	1.19	.09	.068	--	--	9.4	7.8
4332	16.04	--	11.3	88.9	1.38	.08	.081	--	91	9.5	7.5
4333	17.35	86.3	13.0	86.5	2.25	.00	.066	.018	80	--	7.8
4335	17.47	83.2	13.1	86.6	2.41	.02	.071	--	88	9.0	7.8
4339	15.35	84.4	13.2	84.5	2.50	.02	.085	--	90	8.7	7.7
4347	17.37	85.0	13.7	86.2	2.60	.00	.069	.024	85	--	8.7
4349	17.34	--	13.1	89.7	1.94	.00	*--	--	96	9.6	7.3
4350	16.50	--	11.5	88.5	1.39	.02	.068	--	94	9.4	8.2
4354	15.51	83.7	11.5	85.6	2.50	.09	.059	.017	--	--	7.1
4359	16.42	87.8	11.8	89.2	2.50	.00	.082	--	91	8.7	7.7
4366	17.34	90.2	11.1	90.6	2.17	.00	.075	.015	100	--	8.7
4369	17.69	86.2	13.7	87.0	2.05	.09	.077	--	90	8.9	7.9
4373	15.65	85.6	11.3	86.8	1.82	.00	.082	.028	94	--	9.4
4376	15.47	87.1	11.6	88.4	2.16	.57	.071	.013	101	9.1	8.4
4380	14.92	83.2	12.6	84.8	1.72	.75	.067	--	88	8.8	8.0
4382	15.90	--	10.9	88.3	1.25	.14	.071	--	--	9.6	8.3
4394	18.21	84.1	13.6	87.3	2.38	.50	.075	.012	86	8.3	7.8
4396	18.52	--	15.0	89.0	3.29	.00	.090	.030	95	--	--
Avg.1942	15.56	--	11.9	87.0	2.07	0.11	0.077	0.016	92	9.1	8.2
Avg.1943	16.51	--	12.6	87.2	2.14	0.14	0.074	0.017	92	9.1	8.2

* 1st carbonation pH -4315-10.5, 4316-10.7, 4349-11.1

TABLE I

PROCESS DATA, STEFFEN

Sample Number	Beets		Diffusion Juice		Lime Used %	Soda Ash lbs.	Carbonation Alkalinities		2nd Carb'n		Thin Juice pH
	Sucrose	Purity	Brix	Purity			1st	2nd	Temp. C°	pH	
4307	17.83	--	12.2	88.7	2.46	0.33	0.066	--	92	9.1	7.9
4320	16.34	88.0	12.3	88.8	3.01	.04	*--	--	93	9.3	8.7
4326	15.75	--	11.4	86.5	2.60	.93	.052	--	90	9.1	8.4
4327	16.89	83.9	12.1	86.5	3.56	.68	.075	0.017	96	8.9	8.9
4328	15.28	78.8	12.6	82.9	4.20	.17	.069	--	85	8.1	8.0
4329	15.43	85.0	12.2	86.7	3.47	.93	.073	.016	96	--	8.1
4330	15.37	--	11.0	87.5	2.52	.29	.061	--	95	9.1	8.0
4331	15.85	85.8	13.4	86.5	3.27	.21	*--	--	95	8.9	7.7
4337	16.15	88.2	13.0	89.9	2.39	.23	.059	--	91	9.2	8.2
4340	15.97	86.0	11.2	87.3	2.78	.56	.055	.010	96	--	7.6
4341	16.44	--	10.8	88.2	2.45	.25	.059	--	85	9.3	7.9
4342	16.62	--	11.0	88.5	2.58	.18	.071	--	89	9.2	7.8
4346	16.01	85.1	12.1	85.6	3.79	.29	.073	.017	94	8.7	7.3
4353	15.52	86.1	10.9	87.7	3.21	.15	.064	.015	95	8.7	7.4
4356	15.74	--	11.3	85.6	2.36	.74	.071	--	86	9.3	8.1
4357	17.35	84.4	14.1	85.4	5.28	4.14	.078	.014	95	--	8.3
4360	15.38	86.7	11.6	88.3	4.20	.00	.068	.018	100	9.5	8.1
4363	16.76	84.2	11.2	87.6	4.35	1.10	.083	--	98	9.4	9.4
4364	18.72	83.1	15.4	83.9	4.45	.92	.068	--	--	8.8	8.8
4365	16.31	--	12.3	87.8	2.53	.14	.062	.020	89	--	7.8
4371	17.70	86.6	14.8	88.1	3.84	.65	*--	--	85	9.1	8.6
4372	15.68	--	10.5	87.5	2.45	.46	.062	--	85	9.3	8.1
4375	14.66	--	11.4	81.6	3.68	.00	.073	--	93	9.3	9.3
4377	16.07	85.5	11.9	86.6	3.00	.01	*--	--	87	9.3	8.2
4378	15.84	82.5	14.0	82.6	3.75	2.07	*--	--	83	8.6	8.6
4379	15.52	85.0	11.9	87.7	2.47	.00	.074	.014	97	--	7.6
4383	16.68	83.1	13.4	86.2	3.75	.00	.081	--	97	7.8 1/	7.2 1/
4384	17.38	87.5	14.0	88.3	3.12	.00	.082	--	91	9.2	8.8
4395	17.98	84.4	14.8	87.8	3.16	.79	.066	.013	--	--	7.7
Avg.1942	15.16	--	11.6	86.0	3.73	0.49	0.070	0.016	93	9.0	8.4
Avg.1943	16.26	--	12.3	86.7	3.27	0.55	0.069	0.016	92	9.1	8.2

* 1st carbonation pH, 4320-11.1, 4331-10.6, 4371-11.1, 4377-11.0, 4378-11.2

1/ pH at operating temperature

TABLE 2

PROCESS DATA, NON-STEFFEN

Sample	Thin Juice		Thick Juice			Standard Liquor or Blow-up				White Massecuite		
						Filtration						
Number	Sulphur lbs.	pH	Sulphur lbs.	pH	Purity	Brix	Aid lbs.	Temp. C°	Lime Salts	Brix	Purity	pH
4301	0.38	8.7	0.11	9.1	91.5	61.0	0.92	103	0.037	91.1	92.3	8.5
4303	.60	7.7	none	9.2	--	67.8	.27	89	--	90.2	91.6	9.3
4304	none	9.3	.40	9.6	92.5	62.8	.96	91	.015	91.7	90.6	9.6
4305	.52	8.6	none	9.1	91.0	68.1	.52	93	.042	92.2	93.0	8.9
4306	.26	--	none	8.7	91.0	61.6	.97	95	.046	91.7	92.6	8.7
4308	.32	8.1	none	8.8	92.6	69.4	.57	94	.041	91.6	93.2	8.4
4310	.48	8.2	none	8.8	--	69.4	.35	88	.024	91.7	91.2	8.8
4311	.57	8.1	.03	9.3	--	68.9	.27	88	.018	91.5	90.7	9.0
4313	.26	8.2	.26	9.5	92.5	67.9	.89	95	.027	91.3	93.5	8.2
4314	.17	8.4	none	8.8	89.7	65.4	.42	97	.092	92.2	91.9	8.8
4315	.57	8.5	.03	8.0	89.4	65.6	.85	93	.104	89.7	92.5	--
4316	.42	8.2	none	8.8	91.7	68.7	.33	94	.061	91.2	92.5	9.0
4317	.31	9.0	none	8.0	92.2	66.1	.78	86	.047	91.7	94.3	--
4319	none	9.0	.31	9.3	89.0	65.6	.67	92	.041	91.0	91.0	9.1
4321	.48	8.1	none	7.8	89.5	66.7	.76	94	.069	91.6	92.1	--
4322	.46	7.9	none	--	--	70.1	.27	91	--	91.2	91.2	8.7
4325	.59	7.8	.02	8.5	--	71.1	.47	92	.018	--	91.3	8.6
4332	.47	7.5	none	8.7	--	68.6	.42	92	.014	91.7	91.7	8.6
4333	.48	7.8	none	8.0	91.9	60.5	--	90	.048	91.2	87.9	7.9
4335	.47	7.8	none	9.0	91.3	63.1	.43	92	.031	91.4	93.7	9.0
4339	.38	7.7	none	8.3	89.7	64.6	.66	91	.068	92.0	91.4	8.3
4347	.28	8.7	none	8.5	91.4	64.1	.40	90	.025	90.8	92.2	8.2
4349	.92	7.3	none	7.8	93.1	65.0	.69	96	.017	91.4	93.5	--
4350	.27	8.2	.20	9.2	91.2	70.8	.53	85	--	90.9	92.4	9.1
4354	.77	7.1	none	7.1	89.6	60.9	.73	85	--	92.1	91.4	7.1
4359	.98	7.7	none	8.3	92.9	65.8	.55	97	.017	90.5	93.3	8.0
4366	.12	8.7	.25	9.8	93.3	62.2	.56	92	.019	91.3	93.6	9.2
4369	.39	7.9	none	8.8	92.0	68.2	.30	96	.044	91.3	92.5	9.0
4373	.18	9.4	.41	10.3	90.7	63.5	.41	95	.061	91.3	92.8	9.0
4376	.29	8.4	none	8.8	92.1	68.3	.52	95	.043	92.6	93.6	8.7
4380	.33	8.0	none	8.8	89.6	69.5	.65	94	.060	91.6	91.1	8.9
4382	.46	8.3	none	8.8	91.7	71.2	.28	90	.019	91.2	91.8	8.8
4394	.40	7.8	.04	8.5	90.6	63.4	.35	94	.097	91.8	92.2	8.4
4396	.31	--	.15	--	90.7	63.6	.12	92	.022	91.8	91.6	8.2
Avg.1942	*--	8.2	--	8.8	90.9	66.8	.49	92	.038	91.5	92.3	8.7
Avg.1943	*--	8.2	--	8.8	91.3	67.6	.56	92	.041	91.4	92.1	8.7

*Average total sulphur used in 1942 0.45 lbs. per ton beets
" " " " " 1943 0.47 " " " "

TABLE 2

PROCESS DATA, STEFFEN

Sample	Thin Juice		Thick Juice			Standard Liquor or Blow-up				White Masseeuite		
Number	Sulphur lbs	pH	Sulphur lbs	pH	Purity	Brix	Filtration Aid lbs.	Filtration Temp. C°	Lime Salts %	Brix	Purity	pH
4307	0.43	7.9	none	8.7	--	68.8	0.63	92	0.024	90.9	92.3	8.7
4320	.30	8.7	0.16	9.2	91.1	71.5	.23	90	.032	91.5	92.2	8.4
4326	.39	8.4	none	9.1	91.3	67.0	.59	90	.037	90.9	91.4	9.1
4327	none	8.9	.37	9.6	91.7	66.3	.77	95	.002	90.5	93.3	9.3
4328	none	8.0	.50	9.0	88.1	65.8	.71	87	.129	90.9	89.6	8.5
4329	.38	8.1	none	9.2	90.7	64.4	.53	93	.029	91.8	92.9	9.1
4330	.59	8.0	none	8.8	90.4	71.3	.69	85	.037	89.8	90.8	8.9
4331	.55	7.7	none	7.6	91.7	67.7	.66	--	.037	90.1	92.3	7.2
4337	.34	8.2	none	8.7	92.3	66.7	.34	91	.054	91.3	93.4	8.4
4340	.64	7.6	none	7.8	91.4	65.2	.80	82	.036	92.1	90.7	7.8
4341	.38	7.9	none	8.3	--	69.6	.55	98	--	90.9	92.4	8.5
4342	.36	7.8	none	8.6	--	69.0	.49	100	.029	90.9	92.4	8.7
4346	.40	7.3	.37	7.2	89.8	69.4	.76	86	.045	90.8	92.1	--
4353	.50	7.4	none	7.9	93.3	66.1	.98	91	--	91.4	94.3	8.3
4356	.52	8.1	none	8.5	--	68.5	.71	93	--	91.3	91.1	8.7
4357	.64	8.3	none	7.7	88.8	66.8	1.03	89	--	91.1	91.9	--
4360	.38	8.1	none	8.6	92.4	69.2	.61	90	.021	90.8	94.7	--
4363	.05	9.4	.38	9.7	91.7	65.3	1.05	96	.014	91.9	92.8	8.7
4364	.39	8.4	none	7.6	87.3	66.5	1.28	98	.092	91.0	93.6	7.2
4365	.39	7.8	none	8.8	--	70.6	.52	88	.037	89.6	91.0	--
4371	.24	8.6	none	7.9	92.2	65.7	.51	94	--	90.9	93.9	7.7
4372	.32	8.1	.22	8.7	90.6	70.1	.78	92	.035	92.3	90.6	8.6
4375	.32	9.3	.04	9.7	90.2	--	.26	87	.085	90.4	92.5	8.6
4377	.30	8.2	none	--	--	68.3	.27	93	.028	90.8	92.3	8.8
4378	.37	8.6	none	9.0	86.8	69.2	.94	91	.060	92.2	91.9	9.1
4379	.62	7.6	none	7.6	90.0	57.0	.98	93	.088	91.2	91.1	7.6
4383	.19	*--	none	7.6	89.9	60.7	.37	92	.140	91.6	93.0	7.6
4384	.49	8.8	none	--	--	66.0	.41	99	.035	91.7	92.0	8.1
4395	.34	7.7	.12	7.6	90.2	65.2	.67	94	.210	89.7	89.6	7.1
Avg.1942	--	8.4	--	8.6	90.6	66.3	0.63	92	0.068	91.1	92.1	8.3
Avg.1943	--	8.2	--	8.5	90.6	67.1	0.66	92	0.049	91.1	92.2	8.4

Average total sulphur used in 1942 0.38 lbs per ton beets
" " " " " 1943 0.45 " " " "

*pH at operating temp. 7.25

An examination of the drop in pH due to sulphuring of thin juice indicates that in 90% of the factories the drop averages approximately 0.3 in pH for each 0.1 lb. of sulphur used. In four instances very small changes were reported for 0.5 lbs. of sulphur used and it may be assumed that the values given were in error or the sulphuring operations were exceptionably poor. If the thin juice before and after sulphuring shows a pH difference much smaller than that determined from the average relationship just given, then the efficiency of the sulphuring operation is probably below normal. When sulphuring is applied to the thick juice the average drop in pH is again about 0.3 pH for each 0.1 lb. of sulphur used, as indicated by the change in pH between thick juice and white massecuite.

4. pH Change from Thin Juice to Thick Juice

A rather thorough examination was made of all data which might have a bearing on this subject. It is evident that nearly all juices of intermountain and great plains areas decidedly increase in pH during evaporation, that in the far west most juices decrease in pH and that in the east the changes are variable but small. No cause can be found for the exceptions to the general trends in the different regions. Data obtained from analysis of white massecuites of the 1941 campaign, as well as the analysis of the annual sugars, all indicate that high sulphates and high chlorides, with generally low organic salts characterize the juices of the intermountain and plains areas. The far western juices have high chlorides while the eastern are low in mineral salts and high in organic salts.

There is evidently a possibility that high second carbonation temperatures tend to keep down pH increases and also that a thin juice, pH below 8.0, favors a small increase. The regional climatic and plant food effects on the non-sugar composition of the juices are so pronounced that operational technique rarely alters the direction of the pH change, but probably does affect the amount of it.

5. Standard Liquor and White Massecuite

The average density for filtration of standard liquor and blow-up shows an increase over 1942 by about 1° Brix. This may be the result of the higher density of diffusion juice. Only 20% of the factories filtered at densities below 65°, as compared with near 30% in 1942. The temperature of filtration was unchanged. The average quantity of filteraid used showed a further increase.

The white massecuite purities were essentially unchanged, about 60% exceeding 92° purity. This corresponds closely to 1942 operations. Also unchanged were the pH and Brix of white massecuites. The average yield of sugar per cu.ft. decreased slightly for the Steffen factories.

6. Washing White Sugars

In respect of washing and sacking white sugars, the average conditions were unchanged except for a slight drop in moisture on sugar as sacked. Non-Steffen factories had a decrease in the purity of high greens and high wash liquors.

TABLE 3

PROCESS DATA, NON-STEFFEN

Sample Number	White Massecuite				White Sugar as sacked		High Green		High Wash	
	Cu.ft. per 100 lbs.sug.	Wash Water								
		Temp. C°	per mach. qts.	per 100 sug. qts.	Temp. C°	Moisture %	Brix	Purity	Brix	Purity
4301	3.75	85	16.0	6.4	45	0.015	61.6	83.8	62.8	88.5
4303	3.12	89	16.0	3.0	37	.021	78.8	85.2	75.0	90.8
4304	2.45	106	7.2	2.1	51	.028	62.0	80.2	61.2	87.6
4305	2.72	96	16.0	6.0	45	.035	67.7	87.2	--	91.7
4306	2.54	130	12.0	3.0	40	.019	79.4	86.1	--	91.5
4308	3.16	96	18.0	7.0	50	.033	68.0	87.6	--	91.6
4310	3.13	96	18.0	7.0	30	.009	78.5	83.1	81.5	88.8
4311	2.11	91	13.0	4.0	38	.018	73.4	83.2	--	90.6
4313	3.30	87	18.0	5.0	54	.030	81.9	87.7	72.4	92.4
4314	3.15	100	20.0	9.0	48	.029	73.3	85.7	--	90.1
4315	3.13	111	16.0	4.4	43	.039	75.2	86.9	73.8	93.6
4316	3.07	110	14.0	3.1	53	.046	71.2	87.2	70.6	90.7
4317	3.15	91	16.0	4.6	45	.023	71.9	88.8	70.3	94.1
4319	3.10	85	--	--	--	.028	--	82.9	--	88.1
4321	2.82	96	17.0	4.8	47	.028	78.9	83.7	69.6	93.4
4322	2.98	95	15.0	5.6	40	.026	74.3	83.7	--	89.7
4325	3.04	95	17.0	7.4	43	.018	76.8	83.2	--	90.8
4332	3.13	91	17.0	2.6	38	.012	71.5	84.5	--	92.1
4333	3.14	95	20.0	6.0	60	.020	60.0	75.7	65.0	83.9
4335	2.96	99	13.0	4.0	59	.024	78.8	87.5	71.1	93.8
4339	2.99	91	16.6	5.5	55	.041	69.0	85.3	67.0	90.4
4347	2.45	105	15.0	3.3	39	.025	68.4	85.5	67.0	91.2
4349	3.01	90	18.0	6.0	56	.035	78.8	87.1	--	91.9
4350	3.20	94	17.0	6.2	40	.034	78.2	85.6	--	91.0
4354	2.31	96	15.0	3.8	64	.025	77.0	83.9	--	92.0
4359	2.75	91	11.4	3.6	52	.041	--	86.4	--	93.2
4366	2.85	125	14.0	3.7	42	.023	71.1	87.0	76.2	93.2
4369	2.69	92	16.0	6.0	56	.022	75.4	86.2	73.7	91.0
4373	2.69	98	14.0	4.4	36	.025	80.4	86.0	73.8	92.9
4376	2.96	98	15.8	5.3	47	.028	68.8	87.4	--	93.1
4380	3.21	91	16.0	7.0	51	.040	72.9	85.2	--	88.7
4382	2.94	90	18.0	7.5	34	.023	70.6	84.3	--	89.6
4394	3.08	118	15.8	5.5	38	.028	81.1	83.5	75.6	92.5
4396	3.28	80	10.7	4.0	50	.040	72.0	79.3	72.0	81.8
Avg.1942	2.93	96	15.8	5.3	47	0.029	--	85.6	--	91.5
Avg.1943	2.94	97	15.7	5.0	46	0.027	--	85.1	--	91.0

TABLE 3

PROCESS DATA, STEFFEN

Sample Number	White Massecuite				White Sugar as sacked		High Green		High Wash	
	Cu.ft.	Wash Water					Brix	Purity	Brix	Purity
	per 100 lbs.sug.	Temp. C°	per mach. qts.	per 100 sug. qts.	Temp. C°	Moisture %				
4307	3.04	96	15.0	5.3	40	0.030	75.8	86.4	74.4	--
4320	3.00	95	16.0	6.0	52	.026	80.6	85.7	78.7	90.3
4326	3.36	97	19.0	6.3	31	.021	74.9	84.1	70.6	90.9
4327	2.63	98	14.4	4.8	42	.025	65.0	86.2	65.0	91.1
4328	3.60	93	16.0	6.5	40	.031	80.6	82.3	78.4	88.9
4329	2.59	115	15.0	4.9	35	.034	70.2	87.2	--	92.7
4330	3.29	88	14.0	4.2	42	.031	81.4	84.7	78.7	87.7
4331	2.80	117	14.0	4.7	63	.038	74.5	85.8	68.9	94.2
4337	2.72	112	14.0	4.0	37	.022	69.5	87.6	72.5	93.0
4340	3.41	91	15.0	8.0	59	.025	74.8	84.7	79.0	87.7
4341	2.94	98	15.0	5.5	38	.023	77.0	85.6	--	90.8
4342	2.99	92	17.0	--	48	.019	78.8	85.4	--	91.0
4346	3.50	94	16.0	--	48	.054	80.1	84.9	76.1	92.4
4353	2.82	97	16.7	--	54	.021	70.6	87.3	--	94.2
4356	3.17	92	14.0	5.5	35	.016	71.4	83.1	--	90.9
4357	3.03	86	17.0	5.7	55	.040	*76.2	*75.9	--	--
4360	3.00	115	14.8	--	39	.030	70.6	88.7	69.4	94.8
4363	3.19	98	14.2	5.4	64	.037	83.4	86.6	--	92.0
4364	2.91	92	14.0	5.1	42	.035	--	85.3	--	92.9
4365	2.88	92	18.0	6.3	38	.035	77.0	84.4	--	88.4
4371	3.09	85	13.0	5.2	--	.029	73.2	89.3	--	--
4372	3.31	93	12.0	5.0	48	.018	79.1	82.6	--	89.5
4375	3.49	100	15.0	6.8	49	.033	75.9	85.6	71.9	92.7
4377	2.70	97	15.0	2.2	54	.038	85.8	85.7	81.0	91.0
4378	3.00	96	16.0	3.0	40	.024	--	85.2	--	90.6
4379	2.70	94	12.8	--	42	.029	79.8	84.5	--	90.0
4383	2.69	100	22.0	5.4	27	.024	*74.5	*87.0	--	--
4384	2.76	96	18.0	6.0	56	.022	--	84.9	--	89.8
4395	3.07	118	19.4	7.0	48	.030	80.5	79.7	77.1	87.2
Avg.1942	3.12	98	15.5	5.4	46	0.032	--	85.6	--	90.9
Avg.1943	3.02	97	15.5	5.3	45	0.029	--	85.5	--	91.1

* Green and wash not separated

TABLE 4

PROCESS DATA, NON-STEFFEN

Sample Number	High Raw Massecuite			High Raw Sugar Purity	Low Raw Massecuite			Low Raw Sugar Purity	Carbon used per 100 wht. sug. lbs.
	Brix	Purity	Cu.ft. per 100 wht.sug.		Brix	Purity	Cu.ft. per 100 wht.sug.		
4301	91.2	84.0	1.82	98.1	92.4	77.6	1.65	97.6	0.22
4303	92.6	82.5	--	98.2	97.6	72.9	--	92.4	.00
4304	* --	--	--	--	92.3	80.1	0.58	94.9	.00
4305	93.3	85.7	1.80	97.2	95.4	75.7	0.58	91.7	.02
4306	93.3	86.6	2.30	98.3	94.5	76.0	--	93.6	.05
4308	93.5	84.8	1.47	97.3	94.7	74.5	0.42	91.0	.00
4310	94.3	81.5	1.18	95.0	97.5	72.2	0.49	87.8	.00
4311	94.6	83.2	1.37	96.3	98.0	72.7	0.69	87.9	.00
4313	91.7	85.2	0.71	98.0	92.7	78.3	0.72	96.1	.12
4314	93.6	84.5	1.48	98.5	95.7	75.6	0.84	93.1	.00
4315	91.4	86.6	1.56	99.2	91.1	76.4	0.99	93.9	.14
4316	93.1	84.0	1.74	96.8	94.6	73.4	0.56	90.3	.00
4317	91.8	89.0	1.23	99.5	94.7	77.6	0.62	96.3	.11
4319	92.0	84.9	1.49	--	92.1	73.9	0.73	--	.14
4321	93.1	84.1	1.23	99.0	91.8	74.8	0.84	94.8	.14
4322	93.3	82.0	1.18	95.1	97.4	72.3	0.47	90.1	.00
4325	--	81.4	1.12	--	97.8	71.2	0.52	--	.00
4332	93.8	83.3	1.14	98.0	97.8	71.8	0.49	86.9	.00
4333	* --	--	--	--	94.5	75.0	0.51	96.3	.00
4335	93.4	86.9	1.88	98.6	97.0	76.3	0.67	90.1	.07
4339	92.9	84.9	1.37	96.1	94.4	74.0	0.61	90.9	.05
4347	91.9	84.2	1.46	98.6	92.3	74.9	0.43	97.0	.23
4349	91.5	86.4	1.05	97.7	92.8	77.4	0.48	93.9	.08
4350	92.5	81.9	1.39	97.5	97.3	73.2	0.48	87.7	.00
4354	93.3	83.6	1.08	96.8	95.0	73.7	0.50	91.2	.04
4359	92.9	86.0	1.16	97.6	96.7	74.5	0.41	91.7	.00
4366	91.1	84.3	1.29	96.8	94.3	76.4	0.44	94.1	.12
4369	91.4	86.1	1.15	97.2	94.1	76.3	0.60	93.8	.06
4373	94.1	84.4	1.25	99.2	97.7	74.3	0.56	91.0	.15
4376	93.6	85.5	1.33	97.8	93.6	75.0	0.47	91.8	.13
4380	93.4	85.6	1.96	95.9	95.1	74.8	0.87	89.0	.01
4382	93.6	82.8	1.02	97.1	97.0	72.7	0.50	88.4	.00
4394	86.8	84.0	0.93	98.2	94.4	75.0	0.60	94.4	.00
4396	* --	--	--	--	95.0	81.3	0.58	94.6	.18
Avg.1942	92.9	84.7	1.46	97.5	95.3	75.0	0.62	91.7	0.08
Avg.1943	92.8	84.5	1.39	97.6	95.0	74.9	0.62	92.2	0.06

* Two boiling system

TABLE 4

PROCESS DATA, STEFFEN

Sample Number	High Raw Massecuite			High Raw Sugar Purity	Low Raw Massecuite			Low Raw Sugar Purity	Carbon used per 100 wht.sug.	Molasses worked % beets
	Brix	Purity	Cu.ft. per 100 wht.sug.		Brix	Purity	Cu.ft. per 100 wht.sug.			
4307	92.7	83.9	1.40	96.1	94.3	75.3	0.50	88.7	0.08	4.04
4320	91.1	86.2	1.12	97.5	93.9	77.0	0.56	94.5	.00	2.92
4326	92.3	83.3	1.73	98.7	95.0	73.6	0.71	94.8	.00	4.46
4327	91.0	86.7	1.22	99.1	93.4	77.5	0.61	95.2	.10	3.75
4328	86.0	82.7	--	97.6	92.8	76.6	--	94.8	.07	7.10
4329	94.2	85.2	1.73	98.0	96.1	74.7	0.59	93.5	.00	2.72
4330	91.0	84.6	1.35	95.5	94.6	75.4	0.69	89.4	.00	4.89
4331	91.5	86.5	1.52	99.5	91.1	78.6	0.94	95.0	.15	4.41
4337	92.7	85.3	1.41	98.1	94.5	76.1	0.51	90.9	.15	5.49
4340	93.3	83.4	1.03	97.9	93.7	73.1	0.48	90.2	.16	3.19
4341	91.9	84.2	1.32	97.4	93.9	74.8	0.55	88.3	.00	4.91
4342	91.0	83.6	1.46	96.5	93.0	75.3	0.59	89.4	.00	4.69
4346	91.7	86.4	1.24	99.2	92.3	77.6	1.01	92.4	.22	6.55
4353	92.2	87.6	1.13	99.1	93.8	78.4	0.53	90.4	.10	4.22
4356	92.4	82.0	1.67	96.5	97.2	72.7	0.66	87.1	.05	4.25
4357	91.5	85.9	1.86	99.3	92.1	75.9	1.00	94.0	.18	8.92
4360	91.0	88.9	1.46	98.9	92.4	80.6	0.72	93.8	.11	5.75
4363	93.5	86.6	1.54	97.9	92.1	79.0	0.78	94.2	.07	3.81
4364	91.9	87.1	3.01	99.1	94.6	77.2	1.00	95.3	.05	5.59
4365	91.2	83.4	1.27	95.7	94.1	74.0	0.54	87.9	.00	4.45
4371	91.7	87.4	1.45	98.6	92.8	78.3	0.75	96.6	.00	6.03
4372	91.7	81.3	1.23	94.3	95.0	73.6	0.66	90.8	.00	4.47
4375	92.3	85.4	1.59	98.7	94.8	75.4	0.79	95.0	.08	5.12
4377	93.0	85.8	1.12	97.7	93.8	76.3	0.61	91.6	.02	4.18
4378	93.4	86.8	1.90	96.6	95.8	77.6	1.00	93.1	.19	5.37
4379	92.3	83.9	1.40	96.4	94.8	74.0	0.60	89.0	.10	2.86
4383	91.9	86.0	1.15	98.7	92.6	79.5	0.86	97.2	.00	5.38
4384	91.3	85.2	1.10	96.2	92.2	75.6	0.56	91.9	.00	5.32
4395	91.8	80.7	1.64	97.9	91.3	77.6	0.89	93.5	.06	4.83
Avg.1942	91.3	85.3	1.62	97.6	93.0	77.4	0.76	93.2	0.11	5.77
Avg.1943	91.8	85.2	1.46	97.7	93.8	76.2	0.70	92.3	0.07	4.81

7. Raw Massecuites and Remelt Sugars

Both high and low raw massecuites had a slightly lower purity than in 1942 and the cu. ft. of massecuite per 100 of white sugar was also lower. The remelt sugar purities slightly increased, except for the Steffen low raw sugars.

8. Use of Activated Carbon

The average amount of carbon used at factories using this agent was 0.11 lbs. per 100 of white sugar, which is essentially normal. The general averages show a decreased use, as several of the factories which did not operate are normally users of carbon.

9. Storage of Beets

The storage of the sugar beets in piles involved about the usual proportion of the total tonnage. The brief campaign at some factories was compensated by longer than normal campaigns at factories which processed beets for idle plants. Storage losses were in some instances increased by inclusion of frozen beets which produced spoilage.

Experimental studies of the nature of storage losses and of means of reducing same are being continued at the Salt Lake City Laboratory of the Bureau of Plant Industry, Soils and Agricultural Engineering in cooperation with that Bureau and the Utah-Idaho Sugar Company. Results of this work will be reported in the literature.

10. Equipment Changes and Summary

Necessary improvements in factory equipment included a thickener with vacuum filter, two installations of superheated washing of white

sugar, top discharges in plate and frame presses, new sulphuring equipment, automatic pH controls, new continuous Second carbonator, and a new slicer besides the many improvements made by the mechanical services of the factories. All of this indicates progress in spite of difficulties. Similarly the maintenance of proper operating conditions as indicated by the process data just reviewed is an accomplishment.

EXAMINATION OF SUGARS

As already mentioned, it was again necessary to omit the barley candy test, but otherwise the usual analyses were made and are reported in the tables which follow. As on the process data, the results on sugars 4394, 4395, and 4396 are not included in the averages, and the mean of the three parts of sugar 4356 was used instead of the individual values. Some of the shifts in averages may be partly due to idle factories and to non-Steffen operation of some normally Steffen factories. It was found that the effect of these changes on regional averages was so pronounced that this summary by areas has been omitted.

It is suggested that especial attention should be given the partial report on the 1941 white massecuites which follows the discussion of the regular sugar analyses (pages 30-34); also, to the average ash values and corresponding specific conductivity of samples received during the past four years (pages 35-39).

TABLE 5

ASH, SALTS, AND MINERAL COMPONENTS, NON-STEFFEN

Sample Number	Carbonate Ash % Sugar	Sulphated Ash % Sugar	Sepoific Conductivity $X\ 10^6$	Mineral Constituents					Estimated Org.Acd. (combined) ppm	Estimated Salts	
				SO_2 ppm	SO_3 ppm	Cl ppm	CaO ppm	SiO_2 ppm		Total % Sugar	Organic % Total
4301	0.0078	0.0085	23.0	6	3	2	4	1	58	0.0104	76.3
4303	.0086	.0090	20.9	6	11	3	3	0	44	.0104	59.4
4304	.0154	.0207	41.0	5	12	12	2	19	112	.0245	67.2
4305	.0126	.0148	26.6	4	10	3	2	10	120	.0193	78.9
4306	.0122	.0147	25.5	3	7	8	3	7	104	.0184	77.2
4308	.0088	.0114	23.5	7	5	4	3	2	66	.0136	72.3
4310	.0078	.0109	20.8	8	5	6	1	9	48	.0122	57.6
4311	.0152	.0175	33.9	5	30	13	2	11	70	.0197	47.7
4313	.0128	.0160	28.2	8	10	2	3	2	108	.0198	77.1
4314	.0118	.0149	29.0	1	7	13	3	1	94	.0183	75.8
4315	.0088	.0100	22.8	13	5	5	14	2	56	.0114	60.0
4316	.0088	.0106	23.7	4	4	6	5	8	68	.0129	71.8
4317	.0078	.0107	13.6	3	2	5	3	17	64	.0129	71.1
4319	.0148	.0219	32.0	2	16	1	10	25	144	.0276	76.3
4321	.0088	.0131	18.2	10	5	4	4	7	86	.0159	71.7
4322	.0118	.0140	28.2	8	13	8	2	4	68	.0160	69.6
4325	.0124	.0151	22.6	6	8	10	4	3	90	.0181	70.7
4332	.0088	.0111	19.8	9	19	9	3	3	20	.0111	26.1
4333	.0124	.0148	21.0	10	24	5	10	16	46	.0159	39.9
4335	.0070	.0094	20.5	2	11	5	4	4	52	.0112	63.9
4339	.0204	.0215	43.0	8	21	22	20	1	120	.0252	61.4
4347	.0068	.0086	16.8	1	7	0	4	4	64	.0112	82.0
4349	.0126	.0167	29.9	26	17	9	2	7	48	.0170	36.2
4350	.0064	.0088	17.5	4	10	5	4	4	42	.0101	57.3
4354	.0088	.0104	21.5	21	12	9	1	4	0	.0091	00.0
4359	.0126	.0178	36.1	24	16	5	5	2	60	.0188	45.7
4366	.0074	.0099	16.5	1	4	1	4	1	84	.0133	90.0
4369	.0090	.0113	21.3	6	11	2	6	7	58	.0132	63.5
4373	.0104	.0135	26.1	5	14	9	7	1	68	.0156	61.8
4376	.0060	.0066	16.7	4	3	5	2	0	44	.0080	70.2
4380	.0162	.0210	42.0	3	9	25	11	8	102	.0241	63.5
4382	.0088	.0111	21.5	8	9	6	3	3	56	.0127	60.0
4394	.0116	.0148	23.8	5	9	1	14	8	108	.0188	79.4
4396	.0268	.0279	47.3	9	14	5	8	7	182	.0346	79.4
Avg.1942	0.0100	0.0120	22.6	6	9	6	4.5	4.5	66	0.0142	65.7
Avg.1943	0.0106	0.0133	25.1	7	10.5	7	4.8	6	71	0.0156	63.4

TABLE 5

ASH, SALTS AND MINERAL COMPONENTS, STEFFEN

Sample Number	Carbonate Ash % Sugar	Sulphated Ash % Sugar	Specific Conductivity X10^6	Mineral Constituents					Estimated Org.Acd. (combined)	Estimated Salts	
				SO_2 ppm	SO_3 ppm	Cl ppm	CaO ppm	SiO_2 ppm	ppm	Total % Sugar	Organic % Total
4307	0.0112	0.0137	25.8	7	5	3	1	11	82	0.0165	73.2
4320	.0084	.0108	23.9	9	9	9	4	2	44	.0118	51.2
4326	.0070	.0084	17.4	3	7	4	1	2	48	.0100	69.2
4327	.0116	.0143	22.9	3	10	4	1	2	122	.0189	82.8
4328	.0172	.0204	41.1	4	11	20	6	2	110	.0239	67.9
4329	.0082	.0105	23.2	3	4	13	4	3	62	.0124	66.9
4330	.0136	.0170	31.1	6	13	10	2	4	100	.0204	68.8
4331	.0094	.0123	24.1	8	14	6	10	3	54	.0139	54.7
4337	.0116	.0156	30.4	5	12	4	8	4	110	.0196	76.7
4340	.0106	.0136	29.5	25	14	13	5	1	28	.0130	25.8
4341	.0100	.0115	25.2	4	14	8	5	1	60	.0134	60.4
4342	.0080	.0110	22.2	6	9	4	4	8	52	.0127	60.5
4346	.0064	.0086	19.0	6	9	2	3	0	46	.0100	63.9
4353	.0086	.0101	20.8	15	7	5	3	5	28	.0102	38.2
4356A	.0102	.0119	22.9	6	13	10	2	9	34	.0127	41.1
4356B	.0092	.0115	22.9	7	12	9	5	11	38	.0123	43.4
4356C	.0080	.0103	20.0	5	10	7	2	11	48	.0117	54.5
4357	.0074	.0099	20.1	5	8	5	5	7	48	.0113	60.5
4360	.0114	.0144	28.8	10	21	13	6	6	32	.0148	31.6
4363	.0118	.0138	27.8	11	9	5	4	6	68	.0157	61.4
4364	.0064	.0089	14.8	2	8	4	8	9	56	.0109	68.3
4365	.0124	.0153	27.2	5	11	6	5	7	92	.0185	71.1
4371	.0074	.0083	17.0	2	6	2	8	3	62	.0106	76.8
4372	.0104	.0123	26.7	6	19	12	3	1	34	.0130	33.3
4375	.0132	.0165	31.0	5	11	16	11	1	102	.0193	58.3
4377	.0172	.0194	38.9	4	16	15	4	4	120	.0235	59.0
4378	.0116	.0148	24.8	3	17	13	6	6	56	.0164	52.2
4379	.0162	.0194	36.2	14	17	13	11	2	88	.0218	56.7
4383	.0064	.0089	17.2	3	5	4	7	3	52	.0107	72.9
4384	.0104	.0122	22.8	10	12	3	4	2	56	.0138	58.7
4395	.0132	.0162	30.2	5	11	2	12	0	122	.0207	82.1
Avg.1942	0.0126	0.0153	28.4	5.6	9	7	6	4	97	0.0187	75.5
Avg.1943	0.0105	0.0130	25.4	6.8	11	8	5	4	66	0.0150	61.5

1. Ash Content of Sugars

The carbonate and sulphated ash values on sugars from the non-Steffen process averaged slightly above 1942 due to higher ash in about two-thirds of the sugars as compared with decreases in only one-third. However, the Steffen sugars had a considerably reduced ash content on the average as two-thirds of these sugars were lower in ash than the corresponding 1942 samples. The net change for all sugars, non-Steffen and Steffen, was a decrease below the 1942 level. The Steffen sugars equalled the low averages of 1940 and 1941. While the changes in white massecuite purities appear rather too small to account for these shifts in ash on sugar, it may be noted that the trends are as would be expected, that is, the non-Steffen massecuite purity (table 2) was slightly lower than in 1942 and the Steffen purities show a yet smaller increase.

In table 10 the maximum, minimum, and average sulphated ash is given for each factory covering the four years 1940-1943 inclusive. While in some instances the difference between the maximum and the minimum is small, in the majority of cases the variation is very large. For 24 factories the 1943 sugar had the highest ash of this four-year period and for 17 others this years' sugars were the lowest in ash. For the remainder, both the maximum and minimum ash were obtained in other years; in other words, the current sugar of 19 factories was more or less average in this respect. This is a rather satisfactory record considering the difficulty of obtaining experienced labor.

Specific conductivity was as usual determined at a 30 gram per 100 cc. concentration. In table 10 the average for the four years and the calculated factors for sulphated ash are given. The values for the present sugars (table 5) confirm the trends indicated by gravimetric ash. The very low conductivity of No. 4317 as compared with the ash found has been experienced other years. This appears to be the result of high insoluble ash or silica which has been high all four years. The conductivity factors as presented in table 5 are based on total gravimetric ash including acid insoluble ash. In table 10 values are given both on total ash and ash corrected for silica or acid insoluble material. A further discussion of this table is given on pages 35 and 38.

2. Sulphites

An increase in the average amount of sulphites (as SO_2) was found partly due to four sugars being over 20 ppm as compared with only two last year. As previously about 80% of the sugars contained less than 10 ppm SO_2. The increase in the average may be associated with an increase in the sulphur used especially as indicated by the data for Steffen factories, where nearly 20% additional sulphur was used as compared with 1942. Actually the sulphites in sugars increased as greatly in the non-Steffen group where the increase in sulphur used was slight. A total of 27 sugars were higher in sulphites than last year and 19 were lower; the remainder were unchanged.

3. Sulphates

The increase in sulphates (as SO_3) was greater than for sulphites although there was no increase in the number of sugars having over 20 ppm (SO_3). Some 38 sugars were higher in sulphates than in 1942, only 13 were lower, and the remaining nine were unchanged.

4. Chlorides

Chlorides (as Cl) also indicated an increase with three sugars of 20 or more ppm(Cl) as compared with one last year. Just one-half had only 5 ppm or less as contrasted with 65% in this low group in 1942.

5. Lime (CaO)

The calcium oxide (CaO) content showed a slight average decrease, and followed the trends in the lime salts on standard liquor, which were very slightly greater on non-Steffen operations and showed a more pronounced decrease in Steffen operations. The general relationship of lime salts on liquor and the CaO on sugars was pointed out in the last report.

6. Silica

The acid insolubles (or silica, SiO_2) averaged higher in the case of non-Steffen sugars and were unchanged in Steffen sugars. As has been mentioned previously, it is sometimes felt that values for this constituent are inaccurate. However, on examining the data for the past four years, it is noted for in most instances the order of the result on corresponding sugars is quite consistent. The four-year averages were used to correct the total ash to a soluble ash basis for comparison with specific conductivities as reported in table 10. To find this average value for silica, subtract the soluble ash tabulated from the corresponding total ash.

That a few of the values for silica are in doubt is likely as there were instances where the sugar of a particular factory and year was exceptionally high or low when compared with the trend of the other three years.

In the last report, it was mentioned that the use of double filtration might be associated with a lower silica in sugar. Using the four-year averages for silica and filtration equipment data as supplied (as of 1942) it is found that of 43 factories using single plate and frame filtration only 35% show average silica values of 5 ppm or below; 65% are above 5 ppm. With single filtration but top discharge presses (eleven factories) 82% yield sugars of 5 ppm or lower. With double filtration, bottom discharge, 70% of the 17 factories have sugars averaging 5 ppm silica or less. Where both top discharge presses and double filtration are used (12 factories) 83% of the sugars had this low silica (5 ppm) content. All three of the factories reporting using the Vallez-type press show high silica contents in sugar. It is evident that with proper care low-silica sugars are made from liquors that receive the single filtration through bottom discharge presses but the odds are two to one that silica contents above 5 ppm will result. The record is slightly better for top discharge presses than for double filtration with bottom discharge.

TABLE 6

REFLECTANCE, COLOR, ETC., NON-STEFFEN

Sample Number	Reflectance of		Sugar Solution			Foaming Test		Nitrogen (amino) ppm
	Total Sugar	*Screened Fraction	Color (**)	Turbidity (**)	pH	Maximum	Final	
4301	92.0	88.0	1.8	3.4	6.85	97	87	11
4303	92.5	91.5	1.0	1.3	6.98	105	85	5
4304	91.5	91.1	1.3	1.8	7.53	115	90	11
4305	92.4	92.1	1.5	1.5	7.32	100	95	5
4306	92.3	92.0	1.8	3.0	7.05	110	80	7
4308	93.6	92.7	1.3	2.2	6.90	105	80	8
4310	92.6	92.4	1.2	1.8	6.90	110	90	6
4311	91.6	91.4	1.3	2.0	7.10	105	85	13
4313	91.7	91.6	1.2	1.8	7.25	100	80	8
4314	93.1	91.7	2.4	1.6	7.37	105	85	9
4315	93.1	91.8	2.4	3.6	6.70	157	100	15
4316	93.7	92.7	2.2	2.4	7.15	105	85	10
4317	92.9	92.5	1.2	6.8	7.13	105	80	5
4319	91.0	90.8	5.7	5.2	7.62	110	85	1
4321	92.4	91.8	2.0	3.6	6.98	110	95	8
4322	93.5	93.4	0.8	3.3	7.21	115	95	9
4325	92.8	92.6	0.7	1.3	7.10	120	95	9
4332	92.2	92.0	2.2	2.1	7.02	110	85	2
4333	91.6	91.4	1.5	2.6	6.78	140	100	6
4335	93.0	92.8	2.2	2.7	7.39	160	100	5
4339	90.5	90.4	2.1	4.5	7.10	120	95	9
4347	93.0	92.8	2.8	3.9	7.39	142	87	3
4349	92.5	92.4	1.5	4.6	6.70	110	85	11
4350	91.0	90.8	1.2	2.2	7.26	125	90	12
4354	93.4	92.9	1.3	6.3	6.60	100	85	2
4359	93.7	92.8	1.6	1.3	6.81	152	90	8
4366	92.5	92.4	0.9	3.9	7.62	115	85	3
4369	92.3	92.2	2.1	3.9	7.32	135	90	9
4373	93.8	93.7	0.9	6.8	7.00	120	95	5
4376	92.4	92.3	2.4	2.2	7.20	110	80	4
4380	91.7	91.6	4.5	3.3	7.02	200	100	6
4382	92.3	92.1	3.5	2.0	7.18	162	87	14
4394	91.2	91.1	4.5	8.2	7.05	110	90	4
4396	85.7	--	3.3	14.1	7.02	125	85	3
Avg.1942	92.0	91.2	2.06	4.20	6.91	103	81	10.3
Avg.1943	92.4	91.9	1.89	3.09	7.11	121	89	7.5

(*) Fraction passing No. 40 and retained on No. 50

(**) Color and turbidity expressed as $(-\log t)10^3$

TABLE 6

REFLECTANCE, COLOR, ETC., STEFFEN

Sample Number	Reflectance of		Sugar Solution			Foaming Test		Nitrogen (amino) ppm
	Total Sugar	*Screened Fraction	Color (**)	Turbidity (**)	pH	Maximum	Final	
4307	92.5	92.2	1.8	3.0	6.98	100	80	7
4320	91.6	91.2	2.0	2.7	7.10	105	90	3
4326	93.9	93.6	2.4	2.2	7.35	115	80	2
4327	91.4	91.3	4.3	8.4	7.47	120	80	3
4328	91.8	91.7	4.2	5.1	7.30	142	97	4
4329	92.9	92.6	1.9	4.3	7.50	115	85	5
4330	92.4	92.0	2.2	2.7	7.30	210	100	9
4331	91.3	90.5	1.2	3.7	7.00	110	90	3
4337	93.8	93.5	3.0	2.6	7.00	147	95	12
4340	93.0	92.8	1.5	6.7	6.85	115	90	10
4341	93.4	93.1	3.1	1.2	7.15	137	90	4
4342	93.7	93.5	2.4	2.4	7.20	155	87	7
4346	92.4	92.1	2.4	4.1	7.10	100	85	2
4353	93.2	92.9	1.5	4.6	7.00	120	90	9
4356A	93.8	93.6	1.5	2.0	6.80	125	95	9
4356B	92.8	92.7	1.3	1.8	7.19	100	80	3
4356C	93.0	92.8	1.2	1.6	7.20	115	90	7
4357	93.6	92.6	2.4	3.5	6.80	100	85	2
4360	93.3	92.4	1.2	2.4	6.80	182	97	4
4363	93.0	93.0	2.4	4.5	7.00	115	85	11
4364	91.2	91.0	2.1	3.9	6.70	150	100	12
4365	92.6	92.5	1.3	3.6	7.20	202	97	7
4371	93.1	93.0	3.9	3.9	7.00	120	100	5
4372	94.0	93.8	0.7	0.7	7.08	125	95	11
4375	92.7	92.6	1.3	7.2	7.09	132	97	5
4377	91.5	91.4	6.5	4.5	7.40	205	95	4
4378	90.3	90.2	3.9	4.6	7.42	100	85	4
4379	93.0	92.8	2.7	6.4	6.78	105	90	9
4383	92.5	92.4	2.6	2.6	7.02	155	120	5
4384	94.2	94.0	1.8	3.4	7.10	202	105	12
4395	91.4	91.3	7.2	2.5	6.80	177	105	7
Avg.1942	92.1	91.2	2.47	5.22	6.88	102	81	12.4
Avg.1943	92.7	92.4	2.43	3.81	7.10	136	92	6.3

(*) Fraction passing No. 40 and retained on No. 50
(**) Color and turbidity expressed as (-log t)10^3

7. Combined Organic Acids and Estimated Salts

The ash alkalinity was again determined through the SO_3 content of the sulphated ashes, correcting same for the determined SO_2, SO_3, and Cl of the original sugar. The combined organic acid was arbitrarily calculated assuming a combining weight of 80 for the organic radical. A slight increase is noted in averages for non-Steffen sugars and a pronounced decrease in the case of the average for the Steffen sugars. No high degree of accuracy is claimed for an individual value as the testing errors of all constituents are accumulated in the estimation and may affect it considerably. However, the general trends are quite decidedly consistent through the years.

Total, inorganic, and organic salts were estimated as before. Unlike the previous years, the present average values estimated for Steffen sugars are lower than for non-Steffen sugars, both in respect to total salts and proportion of organic salts.

8. Reflectance

Again this year the average reflectance values, both on whole sugar and on the screened fraction show an improvement. All regular samples had a reflectance above 90. Some 38 sugars were higher than in 1942; 15 had a lower reflectance and the remainder were unchanged. The increase in reflectance agrees with some improvement in sugar color in solution but is contrary to the trend toward a coarser sugar as indicated by screening tests.

9. Color and Turbidity of Sugar Solutions

The technique used for the past two years for these measurements was continued. The colors were improved some on the average especially for

the non-Steffen sugars. Individually 32 sugars were higher in color than in 1942 and 25 were of lower color.

The decrease in turbidity was much more marked, in fact the improvement in this respect is very pronounced. Only 12 sugars yielded increased values for turbidity while 44 were of lower turbidity than in 1942. Since color and turbidity values are to some extent complementary, the betterment of both makes the fact of definite improvement in these respects very positive.

10. Foaming Test

Foaming test values were exceptionally high this year following exceptionally low values last year. Extensive supplementary studies failed to reveal any change in technique to account for this. As for the past three reports the procedure has been to heat to near the boiling point while stirring slowly so that liquid temperatures were equalized as well as possible at the moment boiling begins. All especially high values were checked at least twice and agreement between tests was very satisfactory. Distilled water was used for cleaning as well as for the solutions.

11. pH of Sugar Solutions

On the average pH values again increased; none were below 6.5pH. No change in testing technique was made and the quality of the distilled water used was excellent. In most cases the agreement in pH between sugars from the same factory in different years is very good but exceptional contrasts are noted in a few instances.

TABLE 7

RATING AND PURITY OF SUGAR

	NON-STEFFEN			STEFFEN	
Sample Number	Rating Percentage	*Purity	Sample Number	Rating Percentage	*Purity
4301	95.5	99.978	4307	95.2	99.976
4303	97.3	.984	4320	93.5	.985
4304	92.8	.964	4326	96.0	.988
4305	96.5	.975	4327	85.4	.977
4306	94.1	.974	4328	84.4	.972
4308	97.4	.978	4329	93.7	.982
4310	95.8	.982	4330	80.9	.970
4311	94.4	.967	4331	92.8	.983
4313	95.3	.972	4337	89.8	.968
4314	96.0	.972	4340	89.8	.976
4315	87.5	.973	4341	91.9	.982
4316	96.7	.977	4342	90.0	.980
4317	94.3	.982	4346	94.6	.988
4319	85.6	.971	4353	92.5	.980
4321	93.0	.976	4356A	95.1	.978
4322	95.4	.975	4356B	97.2	.984
4325	95.4	.972	4356C	96.3	.981
4332	93.7	.987	4357	96.2	.987
4333	89.3	.978	4360	86.8	.981
4335	89.2	.984	4363	91.7	.973
4339	87.8	.965	4364	87.7	.976
4347	90.1	.985	4365	83.1	.974
4349	90.6	.972	4371	91.6	.984
4350	92.5	.977	4372	97.0	.975
4354	93.6	.989	4375	89.4	.975
4359	88.9	.973	4377	74.0	.972
4366	95.1	.984	4378	89.3	.979
4369	90.1	.975	4379	90.5	.969
4373	93.3	.979	4383	88.8	.984
4376	94.8	.988	4384	84.3	.974
4380	77.9	.970	4395	77.9	.972
4382	86.0	.973			
4394	85.9	.977	Average 1942	92.2	99.968
4396	73.0	.962	Average 1943	89.9	99.978
Average 1942	93.5	99.975			
Average 1943	92.5	99.977			

* Estimated, not polarization

12. Nitrogen (amino)

A change in the testing procedure may be responsible for the generally lower amino nitrogen values found this year. The sugar solution (30 grams per 100 cc) was used directly without preliminary clarification with neutral lead and filtration. A need for further examination of this method is evident.

13. Formula Ratings and Sugar Purities

The formula ratings and sugar purities were calculated on the same basis as last year. The percentage ratings tabulated were based on a standard sugar with formula rating of 81. The generally lower percentage ratings are largely due to the higher foaming tests and agree closely with the results on the 1941 sugars. It is probably more logical to consider the 1942 values as high due to the very low foaming tests obtained that year. As compared with 1941 the non-Steffen sugars show an improvement in percentage rating and Steffen sugars a slightly lower rating.

Calculated sugar purities are essentially unchanged in the case of non-Steffen sugars, but due to the lower salt content and nitrogen values, in the case of Steffen sugars, the resulting purities for these sugars are higher than in 1942.

14. Screening Tests

The screening results indicate a tendency toward a coarser but more uniform grain size. The portions retained on No. 40 screen show a marked increase and those retained on No. 50 screen a decrease. The amount of fines also decreased in most sugars.

TABLE 8

SCREENING TESTS, NON-STEFFEN

Sample Number	Percent Retained on Screens U.S. No. 20	30	40	50	60	70	80	100	Thru 100	Grouped Summary On #30	30-50	50-70	Thru #70
4301	0.0	6.6	53.4	27.8	5.8	3.0	1.8	0.8	0.8	6.6	81.2	8.8	3.4
4303	0.0	0.6	23.6	42.6	10.0	8.2	6.6	5.2	3.2	0.6	66.2	18.2	15.0
4304	0.2	10.6	45.0	25.6	6.6	4.6	3.6	2.2	1.6	10.8	70.6	11.2	7.4
4305	0.0	0.6	33.0	38.6	8.4	7.8	5.8	4.0	1.8	0.6	71.6	16.2	11.6
4306	0.0	2.0	26.2	39.8	11.6	8.6	6.2	3.0	2.6	2.0	66.0	20.2	11.8
4308	0.0	0.4	21.6	42.2	8.8	8.4	7.2	6.2	5.2	0.4	63.8	17.2	18.6
4310	0.0	1.8	44.0	33.2	7.4	5.2	4.0	2.8	1.6	1.8	77.2	12.6	8.4
4311	0.0	2.6	47.4	31.0	5.6	4.4	3.4	2.8	2.8	2.6	78.4	10.0	9.0
4313	0.0	3.0	41.4	31.8	8.2	5.4	4.6	3.2	2.4	3.0	73.2	13.6	10.2
4314	0.0	0.0	8.2	50.2	12.0	10.8	7.8	6.4	4.6	0.0	58.4	22.8	18.8
4315	0.2	1.4	13.2	42.2	9.4	12.0	8.4	7.6	5.6	1.6	55.4	21.4	21.6
4316	0.0	1.2	38.2	38.4	7.6	6.0	4.8	3.2	0.6	1.2	76.6	13.6	8.6
4317	0.0	0.4	21.6	50.0	9.2	7.4	5.6	4.0	1.8	0.4	71.6	16.6	11.4
4319	0.2	2.6	40.8	35.2	7.4	5.8	4.2	2.8	1.0	2.8	76.0	13.2	8.0
4321	0.0	0.2	24.4	48.0	9.0	7.0	4.4	4.4	2.6	0.2	72.4	16.0	11.4
4322	0.0	0.8	30.2	44.2	6.8	6.2	5.2	4.4	2.2	0.8	74.4	13.0	11.8
4325	0.0	0.6	32.2	39.0	8.8	7.4	5.4	4.2	2.4	0.6	71.2	16.2	12.0
4332	0.0	1.0	37.8	38.6	8.4	5.2	4.2	3.2	1.6	1.0	76.4	13.6	9.0
4333	0.0	0.2	29.0	50.8	6.8	5.4	3.6	2.8	1.4	0.2	79.8	12.2	7.8
4335	0.0	0.2	29.4	41.2	7.8	7.8	6.0	5.2	2.4	0.2	70.6	15.6	13.6
4339	0.0	0.4	41.0	41.6	6.6	4.4	3.4	2.2	0.4	0.4	82.6	11.0	6.0
4347	0.0	1.0	34.0	38.0	8.2	6.8	5.4	4.2	2.4	1.0	72.0	15.0	12.0
4349	0.0	0.4	26.0	45.0	6.6	7.6	6.0	5.4	3.0	0.4	71.0	14.2	14.4
4350	0.6	11.6	55.0	23.0	4.6	2.0	1.8	1.0	0.4	12.2	78.0	6.6	3.2
4354	0.0	0.4	15.2	55.2	8.2	8.0	5.4	4.8	2.8	0.4	70.4	16.2	13.0
4359	0.0	6.0	47.4	27.0	6.8	5.0	3.4	3.0	1.4	6.0	74.4	11.8	7.8
4366	0.0	2.2	26.6	39.2	11.2	7.6	6.0	4.6	2.6	2.2	65.8	18.8	13.2
4369	0.0	0.4	30.6	43.8	9.2	6.4	4.2	3.4	2.0	0.4	74.4	15.6	9.6
4373	0.2	2.6	27.4	37.4	10.0	9.0	5.2	5.2	3.0	2.8	64.8	19.0	13.4
4376	0.2	0.8	26.8	47.4	10.4	6.0	4.2	2.6	1.6	1.0	74.2	16.4	8.4
4380	0.2	2.2	33.6	35.4	7.0	7.8	5.8	5.2	2.8	2.4	69.0	14.8	13.8
4382	0.0	0.4	32.4	42.4	8.0	6.2	4.8	3.8	2.0	0.4	74.8	14.2	10.6
4394	0.2	4.0	41.0	33.8	7.6	5.6	3.8	2.6	1.4	4.2	74.8	13.2	7.8
4396	5.6	53.2	33.4	7.0	0.6	0.2	0.0	0.0	0.0	58.8	40.4	0.8	0.0
Avg.1942	0.0	0.8	22.3	44.7	9.7	8.3	6.2	4.9	3.1	0.8	67.0	18.0	14.2
Avg.1943	0.0	2.0	32.4	39.5	8.2	6.7	5.0	3.9	2.3	2.0	71.9	14.9	11.2

TABLE 8

SCREENING TESTS, STEFFEN

Sample Number	Percent Retained on Screens U.S. NO. 20	30	40	50	60	70	80	100	Thru 100	Grouped Summary On #30	30-50	50-70	Thru #70
4307	0.0	0.4	20.8	48.2	10.6	7.2	5.6	4.4	2.8	0.4	69.0	17.8	12.8
4320	0.0	0.2	33.0	43.0	7.4	5.4	4.6	4.0	2.4	0.2	76.0	12.8	11.0
4326	0.0	1.2	43.2	36.8	7.4	4.6	3.6	2.2	1.0	1.2	80.0	12.0	6.8
4327	0.0	0.6	28.0	40.0	8.8	7.8	5.6	5.2	4.0	0.6	68.0	16.6	14.8
4328	0.0	1.6	31.4	41.4	8.4	6.4	5.2	3.6	2.0	1.6	72.8	14.8	10.8
4329	0.0	1.0	25.2	42.0	8.8	7.4	6.4	5.4	3.8	1.0	67.2	16.2	15.6
4330	0.0	1.0	31.4	38.2	8.0	7.2	6.2	5.6	2.4	1.0	69.6	15.2	14.2
4331	0.0	0.6	34.6	41.2	7.8	6.4	4.8	3.6	1.0	0.6	75.8	14.2	9.4
4337	0.0	0.8	27.0	42.6	7.8	8.0	6.2	5.2	2.4	0.8	69.6	15.8	13.8
4340	0.0	0.2	35.0	44.4	6.8	5.4	3.8	3.0	1.4	0.2	79.4	12.2	8.2
4341	0.0	1.4	42.2	32.4	7.4	5.6	4.6	4.0	2.4	1.4	74.6	13.0	11.0
4342	0.0	1.2	24.2	35.6	8.4	7.2	7.4	7.4	8.6	1.2	59.8	15.6	23.4
4346	0.0	1.0	36.6	36.0	7.8	7.0	5.2	4.2	2.2	1.0	72.6	14.8	11.6
4353	0.0	0.2	8.6	54.4	11.2	9.0	7.0	5.6	4.0	0.2	63.0	20.2	16.6
4356A	0.0	0.4	28.4	43.8	8.6	6.0	5.0	4.6	3.2	0.4	72.2	14.6	12.8
4356B	0.0	1.2	46.4	34.4	6.0	3.8	3.6	3.0	1.6	1.2	80.8	9.8	8.2
4356C	0.0	1.0	42.2	37.0	7.0	4.4	3.6	3.0	1.8	1.0	79.2	11.4	8.4
4357	0.0	0.4	21.2	45.8	8.4	8.6	6.6	6.0	3.0	0.4	67.0	17.0	15.6
4360	0.0	1.4	30.0	33.2	9.0	8.4	7.6	6.6	3.8	1.4	63.2	17.4	18.0
4363	0.0	1.4	35.0	36.6	7.8	7.2	5.6	4.4	2.0	1.4	71.6	15.0	12.0
4364	0.2	0.6	42.6	36.4	7.4	5.0	3.8	2.8	1.2	0.8	79.0	12.4	7.8
4365	0.0	0.8	29.6	43.8	9.8	6.2	4.2	3.4	2.2	0.8	73.4	16.0	9.8
4371	0.0	0.4	26.8	46.6	8.4	6.6	5.2	3.8	2.2	0.4	73.4	15.0	11.2
4372	0.2	0.6	34.4	45.4	8.0	4.8	3.2	2.0	1.4	0.8	79.8	12.8	6.6
4375	0.0	1.0	30.8	39.4	8.8	7.2	6.2	4.6	2.0	1.0	70.2	16.0	12.8
4377	0.0	0.2	25.6	50.0	8.6	6.4	4.4	3.4	1.4	0.2	75.6	15.0	9.2
4378	0.2	2.6	44.8	31.8	6.6	5.2	3.8	3.2	1.8	2.8	76.6	11.8	8.8
4379	0.0	0.2	21.0	46.2	9.0	8.8	6.2	5.2	3.4	0.2	67.2	17.8	14.8
4383	0.0	0.6	38.2	39.6	8.0	5.2	3.8	2.8	1.8	0.6	77.8	13.2	8.4
4384	0.0	0.2	15.0	54.0	8.6	8.0	5.6	5.2	3.4	0.2	69.0	16.6	14.2
4395	0.0	3.0	31.6	35.2	8.2	7.6	5.8	5.6	3.0	3.0	66.8	15.8	14.4
Avg.1942	0	1.1	23.6	44.7	10.5	7.3	5.7	4.3	2.8	1.1	68.3	17.8	12.8
Avg.1943	0	0.8	30.5	41.6	8.3	6.7	5.2	4.3	2.6	0.8	72.1	15.0	12.1

15. Ash of White Massecuites vs. Ash of Sugars

In the 1941 campaign composite white massecuites were prepared at the majority of the factories and submitted for special study. The analytical examination of these samples was made late in 1942 after reporting on the regular sugar composites. Presentation of the results has been delayed, but a discussion of a portion of the data will be made here. Many constituents were determined, such as SO_3, SO_2, Cl, and CaO, but at this time particular attention will be given only to the relation of ash in massecuite to ash in the white sugar of the same year.

Table 9 gives the corresponding sulphated ash data and the calculated ratio of the ash in sugar to that in the white massecuite. If sugar end operations were alike at all factories then ash in sugar and in massecuite would have a practically constant relationship. However, sugar-boiling technique and equipment differ, also centrifugal operation and equipment, wash water quality, temperature and amounts vary. Whatever the variables, it still remains certain that the production of a relatively low ash sugar from a particular quality massecuite is an accomplishment and it is the hope that this data will furnish a basis for judging the quality efficiency of sugar end operations as a whole.

That different non-sugar constituents are adsorbed by the growing sugar crystal to different degrees has been well established and is substantiated by the unreported data obtained on these sugars and massecuites. Therefore, it is theoretically possible that two equal amounts of ash in

massecuites might yield varying ash in the sugars if the ash in one case were entirely of a constituent which is taken up by the sugar to a greater degree than average, while in the other massecuite the ash was due to a constituent less readily adsorbed by the sugar crystal. Actually the ash in white massecuites is a complex mixture and while the proportions of various constituents do differ, the balance between readily adsorbable and the less adsorbable constituents varies little. As a result, ash in sugar is still directly related to ash in massecuite except as affected by sugar boiling and washing operations.

It seems logical to assume that the ratio of ash in sugar to that in massecuite found at the majority of the factories represents roughly the normal and satisfactory operating relationship. The values obtained for ash in sugar as percentage of ash in white massecuite were, therefore, examined by making a distribution or frequency curve. It was found that 61% of the factors occur in the range of 0.30 to 0.49, a relatively small group are below 0.30 and the remainder are greater than 0.49. The mean for the larger group is 0.40. Tentatively a factor of 0.40 can then be taken as normal good operating, but due to probable errors in ash determinations and variations in ash composition it seems best to ascribe especially high efficiency only to those showing a factor below 0.30 and to question the operating skill and/or equipment only in cases where the factor is 0.50 or above. Naturally these limits are somewhat arbitrary, but liberal enough to allow for variability in non-sugar composition.

TABLE 9

ASH OF SUGARS VS. ASH OF WHITE MASSECUITES
(1941 Campaign)

Sample Number	Sulphated Ash on		Ash in Sugar as % of Ash in Massecuite	Sample Number	Sulphated Ash on		Ash in Sugar as % of Ash in Massecuite
	Massecuite % solids	Sugars % Sugar			Massecuite % solids	Sugar % Sugar	
01	--	--	--				
02	2.13	0.0079	0.37	46	2.78	0.0120	0.43
03	3.21	.0090	.28	47	2.50	.0232	.93
04	3.37	.0188	.56	48	--	--	--
05	2.25	.0081	.36	49	2.17	.0116	.53
06	2.06	.0118	.57	50	--	--	--
07	2.53	.0080	.32	51	--	--	--
08	2.57	.0092	.36	52	3.33	.0155	.47
09	2.22	.0133	.60	53	--	--	--
10	--	--	--	54	--	--	--
11	3.79	.0143	.38	55	2.98	.0128	.43
12	2.27	.0128	.56	56	3.79	.0087	.23
13	2.50	.0135	.54	57	2.58	.0105	.41
14	2.49	.0103	.41	58	2.40	.0113	.47
15	2.83	.0123	.43	59	2.77	.0144	.52
16	2.66	.0124	.47	60	3.08	.0180	.58
17	2.15	.0070	.33	61	--	--	--
18	2.60	.0117	.45	62	2.88	.0121	.42
19	2.57	.0155	.60	63	2.54	.0141	.56
20	2.23	.0092	.41	64	0.44	.0032	.73
21	3.13	.0108	.35	65	3.05	.0113	.37
22	3.20	.0096	.30	66	2.37	.0149	.63
23	2.67	.0099	.37	67	2.34	.0073	.31
24	2.87	.0123	.43	68	3.16	.0180	.57
25	3.58	.0094	.26	69	2.76	.0135	.49
26	3.44	.0117	.34	70	--	--	--
27	2.35	.0247	1.05	71	--	--	--
28	--	--	--	72	3.65	.0130	.36
29	2.77	.0128	0.46	73	3.75	.0147	.39
30	3.58	.0127	.35	74	--	--	--
31	3.34	.0152	.46	75	3.10	.0142	.46
32	2.93	.0079	.27	76	1.81	.0050	.28
33	--	--	--	77	2.86	.0109	.38
34	2.23	.0082	.37	78	2.74	.0108	.39
35	2.47	.0108	.44	79	2.08	.0134	.64
36	2.13	.0125	.59	80	3.18	.0110	.35
37	2.11	.0140	.66	82	3.07	.0080	.26
38	2.57	.0099	.39	83	2.42	.0085	.35
39	--	--	--	84	3.02	.0152	.50
40	3.11	.0185	.59	90	0.54	.0095	1.76
41	2.94	.0143	.49	91	3.47	.0217	0.63
42	2.90	.0108	.37	94	2.49	.0115	.46
43	2.48	.0091	.37	95	3.74	.0145	.39
44	3.21	.0081	.25	96	3.22	.0323	1.00
45	2.68	.0103	.38	Average	2.732	0.01237	0.452

Very probably other years might find the position of individual factories altered for better or worse, because it is very unlikely that massecuite ash varies anywhere near as much as does ash in sugar.

It is suggested that the determination of ash in white massecuite, on composites corresponding to the sugar composites normally examined at the special laboratories, be included in the laboratory routine. The operating efficiency from the viewpoint of sugar quality may then be judged by the relationship of ash in sugar to that in the massecuite. This could be done on a shift basis or on daily or weekly composites. Use of specific conductivity for estimating ash makes such an addition to laboratory routine only moderately burdensome and there is a possibility that the information obtained may lead to better quality sugars as a result of improved sugar end operations. That is, the evidence of poor operations may lead to equipment or operating changes which will be beneficial all round.

The procedure for handling the massecuites is necessarily more troublesome than for sugars. It is suggested that for preparing composites a tablespoonful of massecuite from each strike be accumulated in a suitable glass container. When ready for testing all the composite must be put into solution using approximately an equal volume of distilled water. When all of the massecuite is in solution and well mixed, the solids concentration is determined preferably by refractometer. The solids must be 27% or higher as the conductivity is to be measured at a concentration of 30 grams of solids per 100 cc. (27° Brix is roughly equivalent to 30 grams solids

in 100 cc). From the solids concentration found, calculate the grams of sirup required to yield 30 grams of solids. This amount of sirup is then weighed out and transferred to a 100 cc volumetric flask and diluted to 100 cc. If more solution than this is required, a multiple of the 30-gram solids unit is used and diluted to the corresponding volume. For example, if the sirup solids determined were 42.5% then 30/42.5 x 100 equals 70.6 grams of sirup required to yield 30 grams of solids. An accuracy of 0.1 gram in weighing the sirup is satisfactory. This concentration of 30 grams solids per 100 cc is the same as recommended for sugar conductivities. Experiments were made at varied concentrations and, as on sugar itself, the maximum conductivity was obtained at the 30 gram per 100 cc. The massecuites and sugars were all tested at this concentration. While the 26-gram concentration which is in common use on sugars will introduce but a relatively small error, it is felt that the 30-gram solution is justified and more satisfactory. The specific conductivity of white massecuites are about ten times greater than that of the sugars. The mean factor found for 91 massecuites examined is 0.00687 for sulphated ash as compared with 0.000517 which is the mean of 326 determinations on sugars. The corresponding factors for carbonate ash and salts will be found in the following section on ash and conductivities.

To briefly repeat, it is suggested that as a check on sugar end operations that at least several times during a campaign a comparison be made of conductivity ash of white massecuite composites and

corresponding white sugar composites. If the ash estimated for the sugar is in the range below 0.50% of the massecuite ash (% solids) it may be assumed that operations are satisfactory from this sugar quality viewpoint. If the ratio is greater than 0.50 then some extra scrutiny of operations and equipment is justified. It is assumed that high ratios may be caused by poor circulation in the pan, by irregular or too much grain, by too high a finishing concentration or high viscosity massecuite from other cause, by too heavy loads in the centrifugals, or by poorly distributed or insufficient washing.

If the ash of white sugar at a particular factory and season is high, due to high ash content of the white massecuite, then the problem is largely agronomic. When justified economically the ash content of white massecuite can be lowered, with consequent improvement in sugar quality, by increasing the production and use of remelt sugars or by remelting the poorer grade white strikes.

16. Four-Year Averages of Ash and Conductivity

Table 10 gives the maximum and minimum sulphated ash on the sugars from individual factories for the past four years. These may be of interest to compare with the 1941 sugars which were used in comparison with the massecuites. It does not seem likely that the ash content of white massecuites would have varied to the degree that the ash content of sugar does in some instances. Where the differences between maximum and minimum are large they must be largely due to sugar end operations.

TABLE 10

ASH AND SPECIFIC CONDUCTIVITY OF SUGARS OF PAST FOUR YEARS

Sample** Number	Sulphated Ash on Sugars 1940-1943 incl.		Specific Conductivity 1940-1943 incl.		Average Soluble Ash ppm	Average Conductivity Factor Corrected
	Range ppm	Average ppm	Average	*Factor		
01	85-109	103	20.5	0.000498	101	0.000493
02	65-110	85	16.2	525	80	494
03	90-107	98	20.0	490	96	480
04	193-208	199	39.1	509	192	491
05	81-148	115	23.5	489	108	460
06	118-147	129	25.1	515	125	498
07	80-137	106	21.2	500	99	467
08	92-122	107	21.1	507	101	479
09	133-194	157	29.7	529	152	512
10	83-109	97	19.2	505	92	479
11	90-175	136	27.1	502	124	458
12	128-220	170	34.4	494	165	480
13	135-160	145	25.3	573	141	557
14	103-149	118	24.2	488	116	479
15	81-123	103	20.7	498	98	473
16	106-132	118	23.2	509	112	483
17	70-107	87	14.0	621	76	543
18	117-160	136	25.6	531	132	516
19	147-252	193	32.9	587	176	535
20	92-120	104	22.1	471	101	457
21	90-131	110	18.5	594	103	557
22	96-140	125	26.4	473	118	447
23	99-171	124	24.1	515	120	498
24	123-166	144	28.1	512	134	477
25	94-151	113	21.4	528	111	519
26	84-152	123	24.4	504	119	488
27	143-247	189	34.0	556	182	535
28	204-230	218	43.6	500	209	479
29	105-128	119	22.8	522	115	518
30	127-182	158	33.0	479	156	473
31	123-164	142	27.1	524	136	502
32	79-111	97	19.6	495	96	490
33	108-148	126	21.8	578	118	541
34	82-97	91	17.9	508	87	486
35	94-144	113	24.2	467	110	455
36	116-224	155	29.9	518	148	495
37	132-174	151	29.2	517	144	493
38	90-110	100	19.1	524	99	518
39	147-214	185	35.1	527	181	516
40	136-186	169	31.6	535	168	532
41	115-144	131	26.0	504	127	488
42	108-148	126	24.0	525	120	500
43	91-121	106	22.3	475	94	422
44	76-113	92	18.8	489	75	399
45	75-103	86	16.6	518	83	500

**Permanent factory sugar number

*Ash divided by specific conductivity

TABLE 10 - (Continued)

Sample** Number	Sulphated Ash on Sugars 1940-1943 incl.		Specific Conductivity 1940-1943 incl.		Average Soluble Ash ppm	Average Conductivity Factor Corrected
	Range ppm	Average ppm	Average	*Factor		
46	86-103	100	18.1	0.000552	97	0.000536
47	86-232	155	31.5	492	153	486
48	166	--	32.4	512	162	500
49	114-167	130	25.8	504	128	496
50	83-88	86	17.0	506	83	488
51	118-164	139	26.6	522	130	489
52	116-155	140	23.5	596	115	489
53	82-107	97	19.1	508	93	487
54	104-190	139	27.2	511	136	500
55	105-162	132	24.7	534	128	518
56	82-119	105	21.9	479	98	447
57	97-122	106	19.9	533	99	497
58	113-305	187	36.3	515	180	496
59	122-178	148	29.0	510	143	493
60	144-231	175	35.3	496	166	470
61	107-136	121	24.1	502	114	473
62	110-186	139	27.0	515	133	493
63	132-151	141	28.7	491	135	470
64	32-97	78	14.0	557	75	536
65	113-153	136	26.4	515	132	500
66	86-149	110	17.6	625	105	596
67	73-111	95	19.3	492	91	472
68	180-213	196	37.8	518	191	505
69	108-135	121	24.2	500	113	467
70	153-166	160	29.2	548	153	524
71	82-98	89	15.8	563	80	506
72	125-188	151	29.4	514	146	497
73	135-156	144	29.4	490	142	483
74	128	--	24.0	533	128	533
75	142-165	152	30.6	497	150	490
76	50-70	63	13.6	463	62	456
77	109-200	159	32.1	495	157	489
78	95-148	121	23.9	506	116	485
79	134-194	152	28.3	537	150	530
80	107-210	136	27.0	504	130	481
81	----					
82	80-134	106	22.2	477	100	450
83	85-98	90	16.7	539	86	515
84	122-165	146	28.8	507	140	486
90	95-146	127	24.1	527	122	506
91	178-217	197	37.0	532	191	516
94	115-148	126	24.9	506	119	478
95	145-162	156	28.4	549	150	528
96	279-323	301	54.2	555	294	542
Average	----	132.3	25.57	0.000517	126.8	0.000496

** Permanent factory sugar number

* Ash divided by specific conductivity

The average ash (sulphated) on sugar and the average specific conductivity for the four-year period are also tabulated. The calculated correlative factor even on this basis is quite variable. Many of the extra high factors appear to be due to high silica or insolubles. This led to the additional tabulation of average ash corrected for silica as roughly determined, and the soluble ash conductivity factors. In general, it is felt that the uncorrected values are more satisfactory. Considering the distribution of the factors it was found that 50% of them fall between 0.000490 and 0.000519, which indicates a slightly lower normal value than found in the actual arithmetical average. In general, the higher factors (when not due to silica) are associated with high proportions of organic salts and low factors with highly inorganic salt compositions.

In the 1941 campaign there was also submitted some 28 non-Steffen-molasses samples which were completely analysed as in the case of sugars and white massecuites. Specific conductivity again was determined at the 30 grams of solids per 100 cc concentration. Conductivities determined at different concentrations indicated the highest value at this condition where moderate differences in concentration produce a minimum change in conductivity.

A tabulated summary of the mean values for ash specific conductivities, and the correlative factors follow:

	Sugar	White Massecuite	Molasses
Number of samples	326	91	28
Specific Conductivity	25.57	397.8	1314.0
Carbonate Ash, %	0.0102	2.28	14.47
Factor	0.000400	0.00573	0.01101
Sulphated Ash, %	0.0132	2.73	17.38
Factor	0.000517	0.00687	0.01322
Sulphated Ash less 10%	0.0119	2.46	15.64
Factor	0.000465	0.00618	0.01190
Estimated Salts, %	0.0159	3.39	20.86
Factor	0.000623	0.00851	0.01587
Carbonate Ash, % below sulphated Ash	22.7	16.5	16.7
Carbonate Ash, % below total Salts	35.8	32.7	30.6

All conductivities were measured at 30 grams solids in 100 cc using an ash bridge. The ash values were all determined at least in duplicate at controlled temperatures, namely 550° C. for carbonate ash and 600° C (1 hr.) after sulphating. Platinum dishes were used throughout. The test sample on sugars was 50 grams, on massecuites 7.5 grams solids and on molasses 2.5 grams solids. It is of course recognized that in spite of care the ash values are not fully accurate, also the relation of specific conductivity to ash is a variable determined by the actual proportions of different ions present. Nevertheless, these average relationships as given can be used with considerable confidence and in most cases the ash estimated from specific conductivity will be closer to the true value than actual gravimetric determinations.

It is immaterial in comparing ash content of sugars and white massecuites whether one uses the sulphated ash factors, as most often

used in this report, or the factor for sulphated ash minus 10% or the carbonate ash factor. The relation of the ash in massecuite to that in the sugar is the matter of concern. Sulphated ash is used in this text largely because it is felt to be a fairer basis for equalizing the effects of mineral and organic salts.

17. Summary

The analytical data on the annual white sugar composites have been reported and indicate a general maintenance of sugar quality. As special subjects, data have been presented on the ash content of white massecuite versus the sugars and on the ash conductivity factors of sugars, massecuite and molasses. It has been proposed that the ratio of the ash in sugar to that in massecuite be utilized for evaluating sugar end operation as it effects sugar quality. The variation of sugar quality in respect to ash at individual factories during the past four years is often great. It is suggested that the general cause of this should be investigated by specific conductivity ash determinations on white sugars and corresponding white massecuites.

BIOLOGICAL STUDIES OF SUGARS

H. H. Hall and Dorothea J. Teunisson

Biological studies were made on the same composite samples of sugars which were described in the chemical and physical studies given in Part I of this report. The biological qualities of the sugars were appraised as to the relative amount of growth-promoting substances present in each sample as determined by the yeast inoculum multiple method and a quantitative examination was made for the number of thermophilic bacteria and mesophilic microorganisms present. The investigation of the growth of molds in highly concentrated sugar solution without preservative, started last year, was continued on the 1942 campaign samples.

EXAMINATION OF SUGARS FOR THE PRESENCE OF VARYING AMOUNTS OF GROWTH-PROMOTING SUBSTANCES

Previous reports of campaign studies have shown that growth-promoting substances are present in samples of different sugars in varying amounts and that this fact is especially important to beverage manufacturers. In the report on beet sugars of the 1942 campaign (mimeographed circular AIC-29) there is a review of the progress that has been made on the study of yeast growth-promoting substances in sugar and references to the literature on this subject are given. One procedure for demonstrating the presence of these substances and determining the relative amounts present in various samples is the yeast inoculum multiple method.

Method

100 ml. of each sample was made (in distilled water) in a 300-ml.

Erlenmeyer flask and was sterilized by autoclaving. Enough extra water was added to allow for evaporation during sterilization. After cooling, each flask was inoculated with a yeast suspension prepared from wort agar cultures incubated for 40 hrs. The cells were removed from the slants by a sterile loop to 100 ml. of sterile distilled water containing glass beads. The concentration of the suspension was determined by counting the cells on a haemocytometer and was adjusted so that it contained approximately 5,000,000 cells per ml. This suspension is designated as the "inoculum" and enough of it was added to each sugar solution to give a final concentration of about 50,000 cells per ml. Water blanks containing 100 ml. were also inoculated in the same manner and the number of cells per ml. in the final suspension were counted on a haemocytometer.

All the flasks were incubated at 30° C. for 72 hours. Sterile glass beads were added to each suspension and the flasks were shaken to break up clusters of cells and the number of cells that developed was calculated by counting 400 duplicate fields on the haemocytometer. The number of cells which developed divided by the number present in the water blanks before incubation is designated as the "yeast inoculum multiple." A correction was made on the yeast inoculum multiple of each sugar sample to allow for the increase which occurred in the blanks.

Results

The results of the yeast inoculum multiple determinations are given in Table I and the samples are arranged in numerical order of increasing multiple values. The range for the 65 samples was 1 to 33.8 and the average was 6.3. A comparison between this average and those

of other years when this same method was used are given in Table II. The average ash content is 0.0112 for the 40 samples having multiples below 6.3 and 0.0107 for the 25 samples having multiples of 6.3 and above. This same data for previous campaigns is also given in Table II. With the exception of 1938 and 1943, the samples with yeast inoculum multiples below average have a lower average per cent ash than those with multiples which are average or above. This shows that there is apparently some correlation between the per cent ash and the yeast inoculum multiples, although there are some samples in most groups with low multiples and high ash content or high multiples with low ash content.

TABLE II

Yeast Inoculum Multiples and Average Per Cent Ash Contents of Sugars for Campaigns 1933-1943.

Campaign Year	Number of Samples			Yeast Inoculum Multiples		Average Per Cent Ash		
	Total	With yeast inoculum multiples below Avg.	With yeast inoculum multiples above and including Avg.	Range	Average	All Samples	Samples with yeast inoculum multiples below Avg.	Samples with yeast inoculum multiples above and including Avg.
1943	65	40	25	1-33.8	6.3	0.0109	0.0112	0.0107
1942	87	53	34	1-18.8	4.2	.0110	.0107	0.0114
1941	87	43	44	1-16.6	6.6	.0091	.0085	.0101
1940	87	45	42	1.1-18.4	8.0	.0095	.0099	.0105
1939	75	45	30	1.9-40.2	9.1	.0110	.0108	.0115
1938	77	47	30	1-25.2	7.6	.0109	.0112	.0107
1937	70	38	32	2.6-19.2	8.0	.0116	.0104	.0130
1936	70	38	32	1.1-27.4	8.6	.0135	.0122	.0144
1935	65	47	18	1.0-59.6	12.4	.0132	.0121	.0160
1934	59	36	23	1.0-13.4	4.8	.0140	.0109	.0174
1933	58	35	23	1.0-30.4	6.7	.0197	.0180	.0224

TABLE I

Ranking of Sugar Samples Collected During 1943 Campaign

Sample Number	Rank	Yeast Inoculum Multiple
4347	1	1.0
4356C	2	1.0
4332	3	1.0
4341	4	1.0
4376	5	1.0
4396	6	1.0
4326	7	1.0
4357	8	1.0
4360	9	1.0
4310	10	1.0
4305	11	1.0
4322	12	1.0
4382	13	1.0
4311	14	1.0
4340	15	1.2
4337	16	2.1
4346	17	2.1
4353	18	2.1
4369	19	2.1
4359	20	2.3
4354	21	2.8
4356A	22	2.8
4335	23	2.9
4308	24	2.9
4304	25	3.1
4307	26	3.1
4314	27	3.5
4350	28	3.8
4319	29	4.0
4339	30	4.0
4364	31	4.2
4375	32	4.6
4378	33	4.6
4330	34	4.8
4306	35	5.5
4383	36	5.7
4313	37	5.7
4317	38	6.1
4325	39	6.1
4377	40	6.1
4327	41	6.3
4356B	42	6.9
4329	43	7.2
4384	44	7.4
4315	45	7.6
4372	46	8.2
4373	47	8.7
4333	48	9.9
4371	49	9.9
4331	50	10.1
4365	51	10.1
4395	52	10.4
4366	53	10.6
4320	54	10.8
4342	55	10.8
4328	56	11.0
4349	57	11.8
4301	58	12.7
4363	59	12.9
4316	60	13.5
4380	61	13.5
4303	62	14.2
4394	63	24.2
4321	64	24.6
4379	65	33.8

BACTERIOLOGICAL EXAMINATION

An examination was made on the samples for the presence of thermophilic bacteria which might influence their use in canned foods and for mesophilic organisms which might impair the quality of frozen foods and desserts, dairy products, or beverages.

The methods which were used are given in the Official and Tentative Methods of the Association of Official Agricultural Chemists, Fifth Edition, 1941, pages 642-3. The bacterial standards that have been adopted for canning-grade sugar are based on the member of thermophilic bacterial spores, and for the purposes of this report they are as follows:

Total Aerobic Thermophilic Spores shall not exceed 125 spores per 10 grams of sugar.

Aerobic Flat Sour Spores shall not exceed 50 spores per 10 grams of sugar.

Anaerobic Thermophilic Hard Swell Spores shall not be present in more than four of the six tubes of media inoculated with the test sample.

Although standards have not been established for the number of mesophilic organisms, it has been suggested that for the use of sugars in the beverage industry the total plate count should not exceed 100 organisms per gram of sugar. Almost complete freedom from yeast and molds is required. The results of this examination are given in Table IV.

No samples exceeded the maximum number of total aerobic thermophilic spores or anaerobic sulfide spoilage spores allowed by the standard. Three

samples, numbers 4328, 4375, and 4384, had an excess number of flat sour thermophilic spores. Only one sample, number 4311 did not pass the standard set for Anaerobic Thermophilic Hard Swell Spores. Four samples out of 65 or 6.2% failed to pass canning-grade specifications.

Samples numbers 4320, 4328, 4331, and 4372 contained an excess number of total aerobic bacteria. This is 6.2% as compared with 5.7% in 1942, and 12.6% in 1941.

Nine samples ~~containd~~ contained yeast but three of these had only 1 per gram, and samples numbers 4337 and 4360 had two per gram, while number 4364 had three per gram. Eleven samples or 16.9% contained five or more molds per gram compared with 10.3% last year.

The total number of samples tested and passing the canning-grade specifications since the 1933 campaign are as follows:

Year	Number samples tested	Number samples passed	Per cent samples passed
1943	65	61	93.8
1942	87	83	95.4
1941	87	77	88.5
1940	87	81	93.1
1939	75	65	86.7
1938	77	74	96.1
1937	70	65	92.9
1936	70	59	83.6
1935	65	47	72.4
1934	59	58	98.3
1933	58	41	71.0

TABLE IV

Bacteriological Examination of 1943 Sugars

	THERMOPHILIC BACTERIA				MESOPHILIC ORGANISMS			
	Aerobes		Anaerobes		Aerobic	Bacteria	Yeast	Molds
Sample Number	Total Count per 10 g.	Flat Sour per 10 g.	Sulfide Spores per 10 g.	Hard Swell % Tubes With Growth	Total per 1.0 g.	Acid per 1.0 g.	Total per 1.0 g.	Number Colonies per 1.0 g.
4301	15	15	0	0	70	42	0	0
4303	40	35	0	0	4	2	0	0
4304	0	0	0	0	0	0	0	0
4305	0	0	0	0	4	2	0	1
4306	25	0	0	0	45	41	0	1
4307	0	0	0	0	4	0	0	2
4308	0	0	0	0	56	10	0	4
4310	0	0	0	0	14	5	0	0
4311	10	0	0	100	6	4	0	1
4313	0	0	0	17	36	18	0	145
4314	0	0	0	0	14	7	0	4
4315	10	0	0	0	5	4	0	1
4316	5	5	0	0	17	13	0	0
4317	10	5	0	0	11	7	0	2
4319	0	0	0	0	6	4	0	0
4320	30	30	0	0	105	105	0	3
4321	10	5	0	17	12	8	0	3
4322	0	0	0	0	15	4	0	0
4325	5	5	0	17	11	9	1	22
4326	10	0	3	0	12	11	0	2
4327	40	10	0	0	12	11	0	8
4328	105	60	0	0	117	94	0	8
4329	65	25	0	0	5	4	0	6
4330	15	5	0	0	16	0	0	2
4331	25	20	0	0	*	*	0	12

* Impossible to estimate number of aerobic bacteria.

TABLE IV (CONTINUED)

Bacteriological Examination of 1943 Sugars

	THERMOPHILIC BACTERIA				MESOPHICIC ORGANISMS			
	Aerobes		Anaerobes		Aerobic	Bacteria	Yeast	Molds
Sample Number	Total Count per 10 g.	Flat Sour per 10 g.	Sulfide Spores per 10 g.	Hard Swell % Tubes With Growth	Total per 1.0 g.	Acid per 1.0 g.	Total per 1.0 g.	Number Colonies per 1.0 g.
4332	0	0	0	0	5	2	0	0
4333	0	0	0	0	50	46	0	30
4335	10	0	0	0	8	3	0	1
4337	20	15	0	0	20	13	2	0
4339	0	0	0	0	46	35	0	3
4340	25	20	0	0	9	5	0	2
4341	45	40	0	0	18	9	0	0
4342	35	20	0	17	10	0	1	0
4346	20	0	0	0	5	3	0	3
4347	20	15	0	0	6	0	0	0
4349	15	5	0	0	62	51	0	0
4350	60	45	0	0	2	2	0	21
4353	15	5	0	0	13	9	0	5
4354	0	0	0	0	13	8	0	3
4356A	0	0	0	0	19	2	0	1
4356B	5	0	0	0	29	2	0	0
4356C	10	5	0	0	19	0	1	0
4357	50	50	0	0	45	45	0	16
4359	0	0	0	0	10	2	1	0
4360	5	5	0	0	8	1	2	0
4363	20	10	0	0	35	5	1	3
4364	0	0	0	0	15	4	3	0
4365	5	0	0	0	37	33	0	1
4366	5	0	0	0	0	0	0	0
4369	0	0	0	0	9	1	1	2
4371	5	5	0	0	6	3	0	0

TABLE IV (CONTINUED)

Bacteriological Examination of 1943 Sugars

	THERMOPHILIC BACTERIA				MESOPHILIC ORGANISMS			
	Aerobes	Anaerobes			Aerobic Bacteria		Yeast	Molds
Sample Number	Total Count per 10 g.	Flat Sour per 10 g.	Sulfide Spores per 10 g.	Hard Swell % Tubes With Growth	Total per 1.0 g.	Acid per 1.0 g.	Total per 1.0 g.	Number Colonies per 1.0 g.
4372	10	5	0	0	360	176	0	1
4373	5	5	0	0	17	2	0	0
4375	110	60	0	0	57	16	0	0
4376	15	5	0	17	12	2	0	1
4377	10	5	0	0	30	24	0	0
4378	40	25	0	0	8	1	0	0
4379	30	15	0	0	13	7	0	6
4380	20	10	0	0	5	3	0	2
4382	15	15	0	0	12	7	0	0
4383	0	0	0	0	8	2	0	1
4384	105	60	0	17	3	1	0	0
4394	20	10	0	0	22	1	0	5
4395	35	25	0	0	20	13	0	1
4396	90	90	0	50	60	12	0	3

GROWTH OF MOLD IN HIGHLY CONCENTRATED SUGAR SOLUTIONS

The growth of molds in highly concentrated sugar solutions is of particular importance to manufacturers of pharmaceutical products. Sixty per cent solutions were made from some of the sugar samples in distilled water. These solutions were sterilized by autoclaving and then after cooling, they were inoculated with a mold, *Penicillium italicum*, which had been isolated from a contaminated sugar solution. After these cultures were incubated for 28 days at room temperature, it was noted that they could be divided into three groups depending on the relative amount of growth of the mold. An attempt was made to correlate the amount of mold growth with the yeast inoculum multiple and with the amount of known non-sugar impurities of each sample, but no correlation was found.

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1941

SUPPLEMENT TO

SOYBEAN PROTEIN--RESUME AND BIBLIOGRAPHY, ACE-62

By George H. Brother, Allan K. Smith, and Sidney J. Circle
U. S. Regional Soybean Industrial Products Laboratory 1/
Urbana, Illinois

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